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PROPHYLACTICS

IN CHARGE OF

MARY M. RIDDLE

THE DISINFECTION OF SICK-ROOMS AND THEIR CONTENTS

WE are told that "micro-organisms may be killed by heat or by the action of chemicals, the processes being generically termed sterilization. The term sterilization is usually employed to denote the destruction of bacteria by heat, in contradistinction to disinfection, which means the destruction of bacteria by the use of chemical agents. A chemical agent causing the death of bacteria is called a *germicide*. An object which is entirely free from bacteria and their spores is *sterile*. Certain substances whose action is detrimental to the vitality of bacteria and prevents their growth amid otherwise suitable surroundings are termed antiseptics."

We know little about the history of the germs with which we are so intimately associated. We have no conception of the long, weary years, full of unceasing toil, spent by the bacteriologists in their laboratories. We may be interested, and an account of the results may sound almost like a fairy tale, but we are wofully ignorant of the things themselves, as well as of the significance of the terms used and their relations to one another. Neither are all nurses able to prepare articles for sterilization, nor are all able to manage a steam sterilizer.

How many know the meaning of the expression "steam under pressure," or the degree of heat used for sterilization, or the length of time required for it, or the class of articles admitting of sterilization by heat, or many more facts that apply to the practical work of disinfection and sterilization.

The study of antisepsis, sterilization, and disinfection naturally leads us to consider the disinfection of sick-rooms and their contents as well as the dejecta and discharges of patients suffering from contagious and infectious diseases. One of the most approved methods of disinfecting the contents of sick-rooms is that of sterilization by steam, which consists in exposing articles to steam under pressure. The terms steam under pressure and super-heated steam are synonymous. It is by the continuance of pressure that we get the heat; this pressure, to be most effective, should be fifteen pounds to the square inch, which means a temperature of 250° F.

It is the action of the heat that destroys the germs, but the advantages of steam over dry heat are twofold. First, the articles are not charred, and, second, the penetrating power of steam makes its action more effective. This method is especially useful for carpets, beds, mattresses, blankets, and certain articles that cannot readily be disinfected in any other way; articles to be subjected to sterilization by steam ought not to be folded.

An ideal steam sterilizer for such purposes consists of a huge iron cylinder having at either end a door of the size of the cylinder end and having within the cylinder upon the floor two steam coils,—a coil of closed pipe and one of perforated pipe. The articles to be sterilized are placed upon the racks or hooks within the cylinder, the doors are closed, and the steam turned on in the closed coil, which causes the temperature of all within the cylinder to rise. When the temperature has reached 110° F. the steam is turned on in the perforated coil and continued under pressure until it has reached fifteen pounds to the square inch, where it is maintained for one hour. At the end of this time the steam is turned off from the perforated coil; the exhaust-valve is opened, by means of which the steam escapes from the interior of the cylinder, and a second valve is also opened to allow a free circulation of air within the cylinder, which should, by this process, be cleared of steam within five minutes, when the door may be opened and all the articles be considered sterile and safe to handle.

The object of heating the cylinder by means of closed pipe is at once seen to be that of preventing the condensation of steam within the cold cylinder and the ruin of the articles to be sterilized.

The following articles are ruined by sterilization with heat: boots, shoes, rubbers, kid gloves, furs, buttons of horn, articles of skins, fur-trimmed garments, feather-trimmed garments, velvets, plush, etc. A mattress tufted with leather buttons should have them removed before sterilization.

There are other means of disinfecting the above-named articles, as with chlorine gas, the fumes of sulphur, and the fumes of formalin; the latter is at present generally practised. Formalin is a forty per cent. solution of pure formaldehyde gas in water, to be further diluted with water for the purpose for which it is required. It is a powerful disinfectant for rooms, furniture, clothes, and the person. It is said to have the same germicidal power as corrosive sublimate without its toxicity.

It is made in various ways chemically, and is also said to occur in those plant-cells which contain the green coloring matter, and is thought to be an intermediate product in that wonderful process known as the formation of starch and sugars from the elements which the plant absorbs from the air. It is also formed by passing the vapor of methyl alcohol (wood spirit) over glowing coke; by this means the alcohol is oxidized, chiefly to formaldehyde.

"The destructive action of formalin on micro-organisms depends upon a number of factors,—the chief of which are its concentration in the surrounding atmosphere, the length of the contact, the existing temperature, the accompanying moisture, and the nature of the organism."

"The necessary concentration of the gas in the surrounding atmosphere to kill the micro-organisms varies with each species, for some resist chemical agents much more than others, and also with the freedom of access of the gas to the bacteria," for if they are under cover or within fabrics, a greater amount of gas must be generated than if they are freely exposed. It was formerly considered that the destruction of bacteria was accomplished only in a dry atmosphere, but further and more recent investigations have proved that a moist atmosphere, even to saturation, aids very materially in the process; therefore if steam may be permitted to escape or be generated in the room in which fumigation by formalin is to take place, the success of the process will be more assured. A fairly high temperature also increases the penetrative power of the fumes as well as their activity: 110° F. represents a degree of heat which aids greatly in rendering the fumigation effective and yet is not high enough to injure the fabrics to be disinfected.

The length of time required for contact with the fumes varies greatly with the kind of bacteria to be killed and depends upon the conditions just mentioned, viz., the concentration of the gas, its access to the bacteria, moisture, and temperature. Even a thin covering renders futile the attempt at disinfection by formalin. An experiment was tried with two handkerchiefs that were saturated with discharges from the nose and throat of patients suffering with diphtheria. One of these handkerchiefs was exposed directly to the fumes of formalin and the other thrust lightly into the pocket of an old coat hanging in the room to be fumigated. This experiment was tried repeatedly, and always with the same result: cultures from the handkerchief in the pocket always grew the bacilli of diphtheria, while the one exposed directly to the fumes produced no cultures that would grow. From this we learned that formalin is a good surface disinfectant and that it must have free access to the bacteria.

The heavier the articles to be sterilized, the greater the amount of formalin required,—our text-books say this amount should vary from one fluid ounce to thirty fluid ounces.

The following rules have been used for sterilization by formalin and have been found effective and practical:

First.—Seal the room and, if possible, allow the escape of steam therein.

Second.—Arrange lamp, which may be a simple alcohol lamp carefully placed in an iron pan or on a piece of marble on the floor in the centre of the room.

Third.—Arrange vessel to contain formalin, which may be an open basin or tincup placed directly over the alcohol lamp.

Fourth.—Use of solution formalin forty per cent., between two and three fluid ounces in vessel.

Fifth.—Use of alcohol two fluid ounces in lamp to generate fumes.

Sixth.—Light the lamp, leave the room, and seal the door.

This is for a space represented by one thousand cubic feet, and the required time of exposure is from five to eight hours. If formalin pastilles are used, fifteen grains per thirty-five cubic feet are required. All articles not sterilized by steam should be subjected to this process, as well as all bed and body linen, before being sent to the laundry.

This amount of formalin is said to destroy such bacilli as those of typhus, diphtheria, and the ordinary infectious diseases. The apparatus formerly used was a complicated one, but this simple one is quite as effective. Every precaution against fire must be taken, as the alcohol lamp is left burning where no one can watch it.

It is not possible to sterilize or disinfect the air of a sick-room during its occupancy by a patient. Since the disinfecting capacity of solutions depends much upon their concentration, it is foolish to place saucers containing these solutions beneath the bed or in different corners of the room. They can do no good, and may do harm by obscuring foul odors (which should be considered danger signals) arising from material that ought to be removed from the room by the possibly more disagreeable odors of the disinfectant.

"During the period of illness a room in which a patient is confined should be freely ventilated, so that its atmosphere is constantly changing and replacing the closeness so universally prevalent during a course of fever by fresh, pure air,—a comfort to the patient and a protection to the doctor and nurse."

How this is to be done depends largely upon the ingenuity of the nurse. Many sick people are afraid of fresh air and have to be urged to take it, but much can be done towards convincing them by always speaking of it as clean air. This term will often appeal to the patient when that of fresh air fails utterly. Again, many fear the inflow of clean air during the night, on the ground that it is night air. This prejudice may be reasoned down by saying that if the patient breathes at all after dark he must breathe night air. Night air is not so life-giving as day air, because it has not been vitalized by sunshine, but it is infinitely more useful than that contained in the sick-room and which has been breathed over and over again. The good thus done in struggling to keep the air pure may be counterbalanced by keeping a gas-jet burning in full force. This uses up the oxygen of the air that rightly belongs to the patient, besides leaving impurities behind it.

The disinfection of excreta demands prompt and unwearying attention. In diphtheria the vomitus, expectoration, and nasal discharge are most important. The last two should be received in old rags or paper, such as paper napkins, and should be at once destroyed by fire. Towels or handkerchiefs ought never to be used for the reception of these discharges lest the contagion be spread. The very towels or handkerchiefs so used may soon be used again about the eyes of the patient; and having these articles washed causes, also, an unnecessary exposure of the laundress.

The sputum of tuberculous patients should be received in glazed earthen vessels that can be boiled or sterilized, or in paper napkins, which can at once be burned. These napkins are not quite as good as the small pasteboard boxes used by some hospitals. It would be well if tuberculous patients could have towels, knives, forks, spoons, plates, etc., kept strictly apart from the others of the household and frequently boiled for considerable lengths of time.

Tuberculous patients should be compelled to use the sputum cups. Even if it is intended to burn all such discharges they should not be allowed to become dry and float about in the air to be inhaled and infect new victims, and they will not if deposited in the cup in a solution of chloride of lime.

Dust from the walls, mouldings, pictures, etc., in rooms that have been occupied by consumptive patients, where the rules of cleanliness have not been carried out, contain the germs and are said to produce tuberculosis in animals when used for their inoculation; therefore such rooms are unsafe for human occupancy and should be thoroughly disinfected and cleaned before they are again occupied. If the sputum of all consumptive patients were destroyed at once when discharged, a large proportion of the cases of the disease would be prevented and the disease itself would be in time wiped out; but the spectacle too often presented in our streets and at our own doors impresses one with the idea that it is a mammoth undertaking, this, of so educating the public that individuals will realize that they have no right to expectorate in the street or in any other place where the sputum may become dry and mix with other dust, to be blown about till it finds lodgement, probably, in the respiratory tract of some innocent victim.

The excreta from typhoid-fever patients require particular attention; these, and, indeed, all matter possibly the source of infection or contagion, should be received in glazed earthen vessels and immediately thoroughly mixed with a five per cent. solution of chlorinated lime if semi-solid or with the powder if liquid, and allowed to stand for an hour before being thrown into the drain. Chloride of lime is one of the most valuable disinfectants; it is cheap and can be used either in the dry powder or in a solution. If kept in the powder form, care must be taken to keep it dry and in an air-tight receptacle.

Dry freshly slaked lime is also a good disinfectant, or milk of lime which is made by dissolving one pound of the dry freshly slaked lime in four or five quarts of water. Lime is slaked by pouring a little water on a lump of quick-lime; the lime becomes hot and crumbles to a white powder. Air-slaked lime has no value as a disinfectant.

Cleanliness and disinfection are so closely allied that one can hardly be mentioned without the other. Any patient's chances of recovery are lessened in proportion as there is failure in this respect; it all involves painstaking care, but the results more than repay the efforts if no new cases develop in the train of the preceding.

A successful surgeon was heard to say that he insisted upon perfect asepsis in his work; that nothing less was sufficient; that, at the close of every operation, while all is fresh in the minds of operator and assistants, he has a written report of just what was done—every step of the operation is recorded and by whom such steps are taken. This is done in order to know just where to fix the blame if all is not well as a result of the technique of that operation.

It may some day be just as possible to tell who is at fault when one of the communicable diseases is transmitted. If it is ever brought about, it will doubtless be due to the efforts of the bacteriologists.

Considering the progress that has been made in the knowledge of the germ theory and its relation to disease, would it be at all strange if ere long we shall have to furnish affidavit to Boards of Health in our cities of our work done in the care of such diseases as these we have been considering?

It may not foster the highest motive to encourage the performance of duty because a law provides for punishment in case of failure,—it is much better to do right for the sake of right,—but since " it is a common principle in ethics that laws are only for law-breakers, they being the only people cognizant of their existence," the law-abiding have nothing to fear.